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Welcome New Subscribers!
If you are receiving this newsletter for the first time, SimLabs News is a quarterly publication reviewing current projects at the NASA Ames Simulation Laboratories (SimLabs). NASA SimLabs is comprised of three unique Flight Simulators, an Air Traffic Control radar simulator and a high fidelity Air Traffic Control Tower simulator. The facilities support government as well as private industry in a wide array of applications. To find out more, read on!

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1. Toward Safer Rudder Control Systems

Figure 1. Airbus A300

No one will forget the tragic crash of the Airbus 300 on November 12, 2001 into Belle Harbor, New York. The National Transportation Safety Board (NTSB) determined the probable cause of the accident was separation of the vertical stabilizer due to forces placed on it by rudder pedal inputs that exceeded the worst case loads used in its design.

SimLabs' Vertical Motion Simulator (VMS) is helping the Federal Aviation Administration address one aspect of this problem in a multi-phase investigation to ultimately revise rudder certification regulations. The investigation will lead to safer handling characteristics for large transport aircraft.

Three phases of testing are planned:

In Phase 1, researchers will determine the necessary lateral motion of a simulator for determining valid pilot response to aggressive rudder control. They will also identify initial flight control criteria for various rudder control system designs. Flight control criteria include various parameters limits such as the force required to push rudder pedals at different air speeds, travel of the rudder pedals, the cable stretch coefficient, and force induced on the tail.

In Phase 2, researchers will conduct detailed experiments to formulate tentative criteria for rudder flight control systems in transport aircraft.

In Phase 3, researchers will validate the Phase 2 results using more complex piloting tasks where rudder use is based on pilot judgment and technique. If necessary, they will refine the criteria developed in Phase 2.

The Phase 1 test was completed recently on the VMS. Utilizing its large, high-fidelity motion platform, the investigator found a significant difference in pilot opinion when full motion was used vs. limited motion (as in a hexapod-style motion system) for aggressive rudder control. The implication is that high-fidelity motion, such as that produced by the VMS, is necessary for valid study of rudder systems of the actual aircraft. The investigator was also able to obtain preliminary rudder flight control criteria for several different rudder designs: variable-stop rudder systems, variable-gearing rudder systems, and force-limit rudder systems, as well as the effect of breakout and yaw damper.

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2. Strategic Trajectories May Reduce Airspace Congestion

NASA Ames researchers are investigating a more efficient way to manage traffic flow by issuing continuous clearances instead of multiple clearances during a flight. A Trajectory Based Automation Experiment was recently conducted at the Crew Vehicle Systems Research Facility

(CVSRF) as part of a long-term effort to study preferred aircraft trajectories and continuous clearances as a solution to airspace congestion.

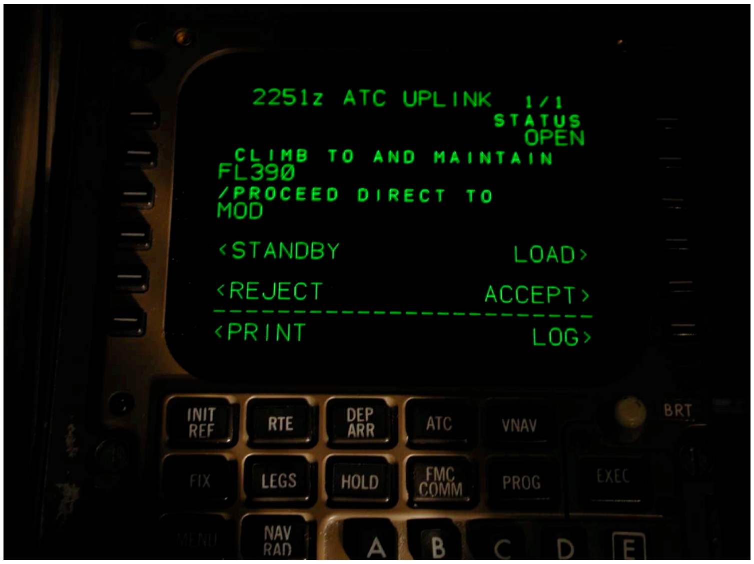

Figure 2: B747-400 Control Display Unit

Researchers using computers to analyze all traffic in an airspace theoretically can devise trajectories which would increase the efficiency of traffic flow. Utilizing the VAST network architecture for distributed simulation, the Center/TRACON Automation System (CTAS) laboratory and the SimLabs' B747-400 simulator, researchers were able to send clearances for a new long-range trajectory directly to the Flight Management System (FMS) in the simulator for inspection and implementation by the pilot.

Clearances and flight crew responses were passed back and forth in an operational manner. Aircraft conditions and flight path data were collected on the 747 for study by the researchers.

This new capability now affords researchers a real time simulation tool to explore trajectory-based operations, such as 4-D trajectories, to solve airspace congestion and conflicts. Future work will look at types and formats of clearances, and the actual aircraft path that is flown. This work is a precursor to fieldwork scheduled in the future.

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3. High-fidelity Simulation: a new tool for the Lunar Program

NASA has not landed human-occupied vehicles on another astronomical body for over three decades but is now planning to reestablish a human presence on the Moon. NASA is envisioning many changes and improvements to the next Lunar Lander spacecraft.

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Figure 3. Apollo era "Flying Bedstead"

For the Apollo missions, a number of devices were used to train the crews for lunar landings, including the Lunar Lander Research Vehicle, called and the "flying bedstead." Since that era, NASA technology has grown to include high-fidelity simulators that will provide a safer and more effective method to develop the Lander design and train astronauts.

High-fidelity full-motion simulation is an essential tool for developing handling qualities for a new class of vehicle such as the Lunar Lander. The need arises from the fact that handling quality assessments rely on subjective evaluations or pilot ratings of the vehicle's flying characteristics (e.g., the Cooper-Harper scale). The NASA SimLabs' Vertical Motion Simulator (VMS) provides a highly realistic environment (motion queues, visualization, and control devices) ideally suited to this type of development.

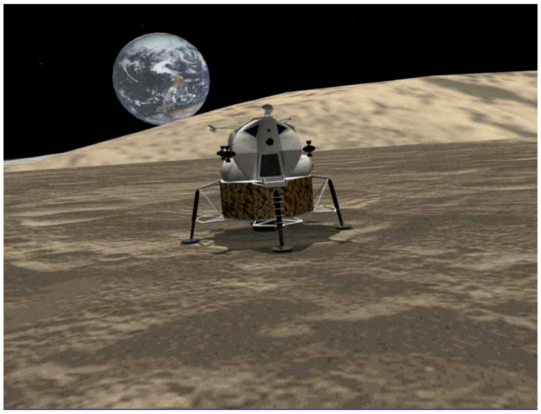

Figure 4. Artist's concept of Lunar Lander

The 2007 Lunar Lander simulation will include the portion of the landing task beginning approximately two minutes before powered descent initiation and continuing to touchdown, allowing the VMS to encompass three phases of powered descent: the braking phase, the final approach phase, and the landing phase. These phases can be simulated, either as independent segments or as a continuous process. The simulation will also include the ability to inject failures and create other off-nominal landing scenarios, such as take-over of an auto-land feature by the pilot.

VMS engineers are also prototyping a standing restraint system with height-adjustable harness that allows the astronauts to lean forward safely with a locking mechanism for sudden forces. As the Constellation Lander design evolves, the VMS simulation will be continually upgraded to allow development, testing, and training activities to take place during the development process.

Figure 5. Interior of VMS cab with 2005 Lunar Lander configuration

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4. Planners To "Stress Test" the Future Ivanpah Airport

To make sure they have considered everything possible in choosing between airport layout alternatives, planners of the future Ivanpah Airport in Nevada are going to "stress test" the airport surface operation *beyond* peak traffic. They will push the limits in FutureFlight Central's high fidelity virtual tower next month as one part of an alternatives investigation. The human-in-the loop simulation will help determine which airfield configuration can more efficiently accommodate a more continuous and demanding flow of traffic.

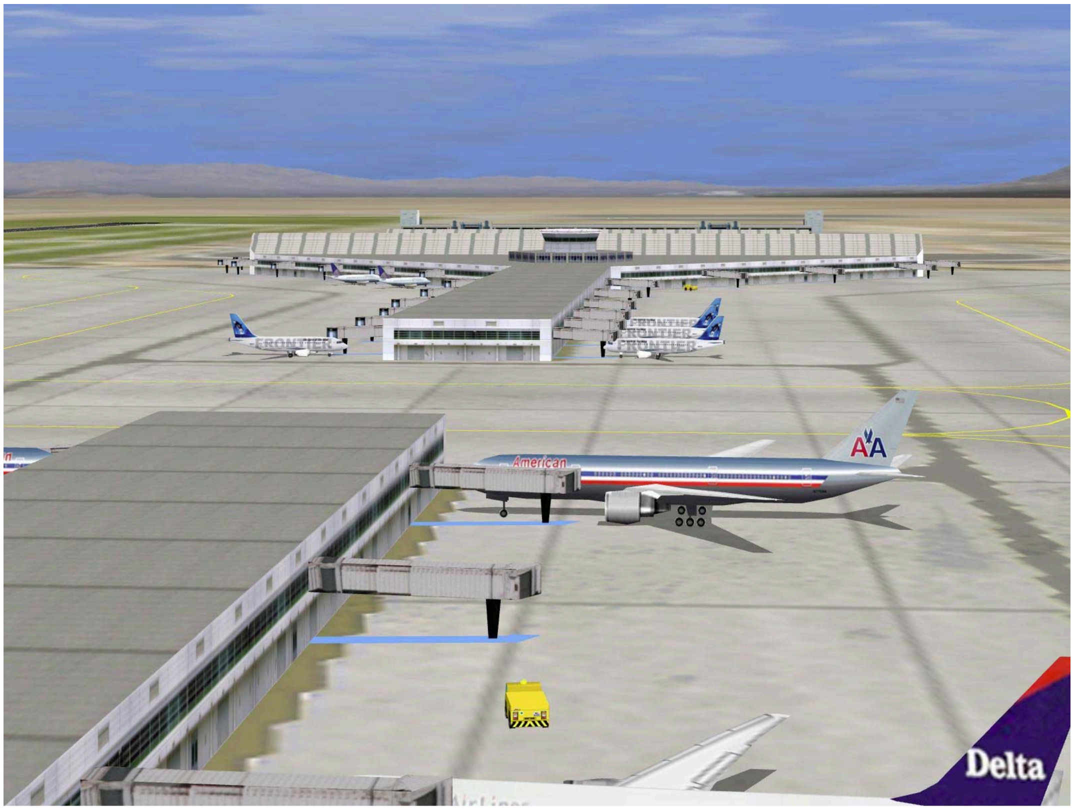

Figure 6. Future Ivanpah Valley Airport

Baseline operations will be assessed first, using anticipated initial traffic runs for each alternative, flow direction and time of day. Surface operation metrics with controllers and pilots "in the loop" with give insight into efficiency and safety considerations for the two plans. The results of the simulation will provide input to the Environmental Impact Statement.

The really interesting runs are the high-stress runs that will follow. Clark County planners think it makes good sense given the investment required to build a brand new airport. They will look well beyond the normal time frame for such studies to see where the human-operated design reaches its limit as an integrated system.

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5. Controllers "See Clearly Now" in FutureFlight Central

Today, a tower air traffic controller's job involves a lot of looking out the window. For example, controllers visually identify aircraft by location, type, and paint scheme; continuously scan the runway for obstacles; and judge other factors such as speed and acceleration for potential conflicts.

Because visualization is such an integral part of the job, NASA SimLabs has recently upgraded the FutureFlight Central tower simulator visual systems to an exceptional level. New PC-based image generators raise the native image resolution to 1600 x 1200 and provide an eight-fold increase in capacity for high-resolution photo textures used in the visual 3D databases. High brightness LCD projectors provide up to 7700 lumens and a contrast ratio of 1000:1 for very sharp images. The images below illustrate the improvement provided by the new system.

These enhancements exemplify SimLabs' commitment to the providing the highest fidelity tools for Next Generation Air Transportation Systems (NGATS) research. Though technology may ultimately eliminate the need for physical towers, FutureFlight Central will help researchers evaluate "Virtual Tower" concepts to determine the visual requirements for non-towered airport operation.

Figure 7. Before and After Illustration of FutureFlight Central's Visual System Upgrades

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6. Thinking of Doing Business with NASA SimLabs?

For more information on what we can do for your needs, contact:

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